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MUSCLE SENSE ORGANS AND DISORDERS OF MOVEMENT

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A simplified account of muscle sense organs and their actions. Attention is drawn to a field of experimental work, outside the central nervous system, which has a direct bearing on fundamental disorders of function inherent in human spasticity and rigidity.

SENSORY nerve endings in limb musculature were observed over a century ago, but a careful description and proof of their sensory nature was given much later by Ruffini and Sherrington in the 1890's. The muscular nerve, therefore, not only carries nerve impulses to activate the muscle ("motor" or "efferent" nerve fibres) but its sensory nerve fibres ("afferents") convey information derived from the muscle itself to the spinal cord and brain. Much of this information, however, is used by centres within the spinal cord, brain-stem and cerebellum to integrate and co-ordinate muscular movement and very little reaches consciousness. Without it, movement is ataxic. About half of the muscular nerve consists of sensory nerve whose sense organs lie inside the muscle and are of four distinct types: (1) muscle spindles; (2) Golgi tendon organs; (3) Pacinian and Golgi-Mazzoni corpuscles; and (4) free nerve endings.

Golgi-Mazzoni corpuscles are small oval organs containing a core of coiled or network-like expansion of the entering nerve fibre. They and Pacinian corpuscles are found in the sheaths of tendons and intramuscular septa particularly, and are thought to be excited by deep pressure, though their exact physiological rôle is not clear. The free nerve endings are also associated with tendon sheaths, but these single, thin, beaded nerve fibres have a wider distribution. They are found near and around the blood-vessels of muscles or in tendons or aponeuroses, and some even surround the connective tissue of the actual muscle fibres themselves (endomysium). They are believed to be the pain receptors of the muscle, and their sensory nerve fibres are termed "group III afferents" because of their relatively slow conduction velocity as compared with the other sensory fibres in the muscular nerve.

The muscle spindle, so named by Kühne in 1863, is a complex sense organ about which much has been written in the last thirty years, but many details of both its structure and function are still awaiting clarification. The spindle-shaped fibrous capsule of the organ lies to one side of a muscle fasciculus and is a few millimetres long (see fig. 1). Inside the capsule, and extending beyond its confines, several small striated muscle fibres traverse the organ from end to end, originating with the surrounding muscle fibres and ending with them either on tendon or on endomysium. The muscle spindle thus lies parallel to its neighbouring muscle fibres. The small muscle fibres traversing the spindle (intrafusal muscle fibres) are differentiated from other muscle fibres not only by their size but also by their nuclei, which are rounder and more

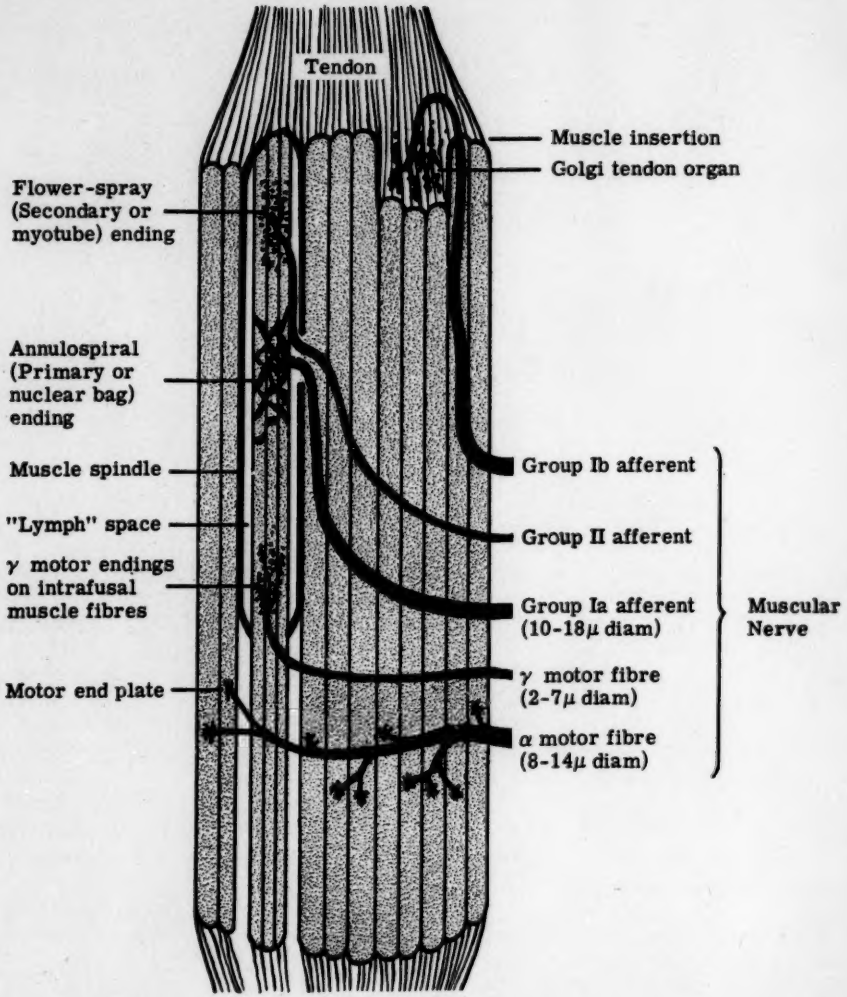

Fig. 1. Innervation of skeletal muscle, modified and adapted from an original drawing by Prof. D. Denny-Brown. Free nerve endings, Pacinian and Golgi-Mazzoni corpuscles, and sympathetic motor fibres are omitted and the motor supply of the muscle is reduced to a minimum for clarity. Similarly the gamma fibre is shown innervating only one end of the intrafusal muscle fibres, whereas in a complex muscle spindle it is often distributed to both distal and proximal portions.

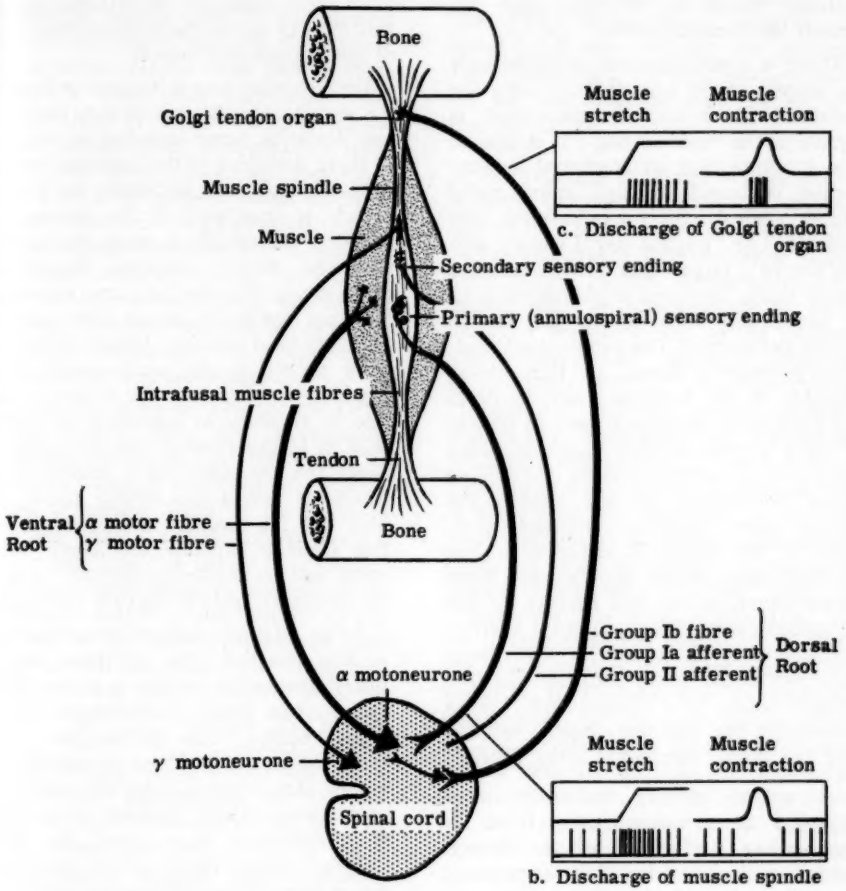

Fig. 2 (a) Innervation of skeletal muscle, very diagrammatic. The motor and sensory fibres are illustrated as having separate routes to and from the muscle; in reality they run together in the muscular nerve and only separate when the main nerve trunk divides into dorsal and ventral roots. The central connections of the group-II sensory fibres are not shown. The group-Ia fibre transmits impulses from the primary ending across one synapse to excite the alpha motoneurone (a monosynaptic reflex). The group-Ib fibre transmits the discharge from the Golgi tendon organ to an internuncial neurone which in turn relays to the alpha motoneurone, where it has an inhibitory action.

(b) Discharge of a muscle spindle as would be recorded from a group-Ia fibre. Its response to muscle stretch and muscular contraction. The spindle may discharge spontaneously at rest; there is an immediate brisk discharge of action potentials (which may be slightly irregular in rate) when the muscle is stretched and a pause of the discharge when the muscle is made to contract.

(c) Discharge of a Golgi tendon organ, as recorded from a group-Ib fibre, to compare with the spindle discharge. The Golgi tendon organ is excited by an increase in muscle tension, either by stretch or by muscular contraction.

centrally placed in the fibre than the normal sarcolemmal nuclei.

There is a concentration of nuclei near the middle of the spindle, distending the intrafusal fibres and forming what is known as the "nuclear bag". It is around this structure that an important sensory ending is found—a large spiral nerve ending called the annulo-spiral (or "primary" or "nuclear bag") ending, giving rise to a large medullated nerve fibre which relays impulses to the spinal cord at remarkably high speeds (60 to 120 metres per second). The annulo-spiral ending is sensitive to stretch, and thus tension changes in the intrafusal muscle fibres are signalled to the central nervous system. When a normal healthy muscle is pulled upon so as to stretch it, there is a definite active counterpull by the muscle, the stretch reflex, which is completely abolished if the muscle is denervated. The receptor organ for the stretch reflex is the annulo-spiral ending and through its fast conducting nerve fibre (group I a afferent) connection is made directly with motoneurones in the spinal cord (fig. 2a). The stretch reflex is a monosynaptic reflex employing the simplest central pathway and the fastest peripheral nerve fibres.

A second sensory ending is often found a short distance away from the nuclear bag. Ruffini called it the "flower-spray" ending because of its appearance in the cat's muscle he was studying, but in other mammals, including man, this is not an apt term so it is often called the "secondary" or "myotube" ending. It also signals tension changes in the intrafusal muscle fibres and its discharge passes along more slowly conducting nerve fibres (group II afferents, conducting at rates of about 40 to 80 metres per second) and through more than one synapse in the spinal cord (figs. 1 and 2a). Its discharge tends to elicit a flexor response, so that the discharge from secondary endings in a flexor muscle will excite its own motoneurone pool, whereas the discharge from these sense organs in an extensor muscle will tend to excite the motoneurone pool of the antagonistic muscle.

Both primary and secondary endings of the muscle spindle are stretch receptors and discharge nerve impulses in response to slight stretching of the intrafusal muscle fibres (which occurs when the whole muscle is stretched). If the muscle surrounding the spindle is made to contract, then the stretch receptors immediately cease firing because they are no longer stretched, the strain having been taken off the intrafusal muscle fibres which are lying parallel to the main muscle fibres (fig. 2b). In this way, the receptors may also be regarded as signalling any difference in length between intrafusal muscle fibres and the surrounding muscle. Their discharge brings the stretch reflex into play and the resulting muscular contraction tends to equalise the length differences and so reduce or stop the firing of the receptors again ("negative feedback").

Apart from the sensory components of muscle spindles, the intrafusal muscle fibres themselves receive a motor innervation from small motoneurones in the spinal cord. Their axones are small medullated nerve fibres conducting at rather slow rates (20 to 40 metres per second) and called "gamma" motor fibres to differentiate them from the larger "alpha" motor fibres which conduct at faster rates (60 to 100 metres per second) and innervate the muscle outside the muscle spindle (fig. 2a). The gamma motor fibres cause tightening of the intrafusal muscle fibres and so increase the sensitivity of the stretch receptors of the muscle spindle. In this way, the sensitivities of the sensory endings of the muscle spindle are under the control of the central nervous system. Gamma motor fibres are more readily blocked by procaine than are alpha motor fibres or group I sensory fibres, as we ourselves have shown.

In patients with spasticity or rigidity the basic disorder of function is a grossly

exaggerated stretch reflex of the affected muscles. It is highly probable that gamma motoneurones play a large part in these hypertonic states and that their over-activity keeps the stretch receptors of the muscle spindle in an over-sensitive state. Indeed, we have found that when procaine blocks the gamma motor fibres of affected muscles in the decerebrate rigidity of experimental animals, or in patients with some forms of spasticity or rigidity, then the hypertonus disappears leaving muscular power unimpaired, owing to the relative insusceptibility of alpha motor fibres to this local anæsthetic.

Finally we have to consider the Golgi tendon organs. These are encapsulated nerve endings situated at the junction of tendon and muscle, and encircling a small bundle of tendon which is the insertion of about twenty muscle fibres (fig. 1). Each organ gives rise to one large medullated nerve fibre (group Ib afferent) which conducts impulses at only slightly slower rates (60 to 110 metres per second) than group Ia afferents fibres. The Golgi tendon organs are thus "in series" with the muscle fibres, in contrast to muscle spindles which lie "in parallel". They, too, are stretch receptors, but because of the "in-series" arrangement they respond during muscular contraction (fig. 2c). The tendon organ has a much higher threshold to stretch than the muscle spindle. The volley of impulses it sends to the spinal cord pass through two synapses before exerting a strong inhibitory action on the motoneurone pool of its own muscle (fig. 2a).

The function of Golgi tendon organs is almost certainly disordered in spasticity and rigidity, which may account for some of the differences between these hypertonic states. Passive displacement of a spastic limb is accompanied by much muscular resistance due to the exaggerated stretch reflex, but with continued displacement there is a sudden melting of resistance and the posture collapses. This is the "clasp-knife" or "lengthening reaction", and is due to the inhibitory effect of Golgi tendon organs on the stretch reflex. We have still to discover what function, if any, the Golgi tendon organ has in plastic rigidity. In this state, passive displacement of a limb calls forth a resistance that is easily overcome and the muscle lengthens sufficiently to allow the assumption of the new posture imposed on it. We have also to remember that muscles do not work independently of one another and that muscle sense organs influence not only the motoneurones of their own muscle but also those of the synergists and, in an opposite manner, the motoneurones of the antagonistic muscles.

THE PROBLEMS AND NEEDS OF PARENTS OF CEREBRAL PALSIED CHILDREN

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A study of the family backgrounds of a group of children with cerebral palsy.

The Project

St. Margaret's School, Croydon, the first recognised "special" school for C.P. children, was also the pioneer in attempting the close integration of a programme of education and treatment specially designed for children severely handicapped by cerebral palsy. It seems natural and fitting that it should be St. Margaret's again which offered facilities for a study of the relationship of the children's home backgrounds with emotional factors in their upbringing. The school went even further in supporting this project by introducing the idea to the parents by means of a personal letter from the Headmistress, Miss Budd. Whilst giving all possible help, however, neither the Committee nor the staff bear any responsibility for the actual planning, preparation and execution, or for the shortcomings of the work.

Plan of Work

At the outset considerable time was spent at the school, studying all the children's records, and it was at this stage that the very simple procedure was agreed. The Headmistress' letter commending the scheme, assuring the parents that it had the blessing of the school and asking for their individual co-operation was sent to the homes of 38 out of the 39 children then on the register (the exception being a child with a home abroad). An acceptance slip was attached which the parents returned if they were willing to co-operate in the enquiry. Thereafter, personal contact was established with them one by one and visits were made by appointment.

It was self-evident that some special difficulties must be avoided in approaching the parents if the possibility of getting a true picture from a single interview was not to be prejudiced. Baffling situations which could not be foreseen would certainly arise, but it was considered very important to word the first letters most carefully so as to minimise any general apprehension on the parents' part that serious emotional disturbances in their own child were being implied or were in any way inevitable. Further, it was decided to base the personal approach to the parents on the value of pooling their experience for study, rather than on any individual help they might expect from a visit.

The social worker naturally had to accept the limitations inherent in the fact that she was not a member of the school staff. Her contact could afford no practical help to the parents (except possible relief from unburdening themselves) because she must avoid entering into discussion of issues which were properly matters between them and the school. In fact, this

*The survey was made possible by a grant from the Medical Research Unit of the National Spastics Society to the National Association for Mental Health.

proved easier than it might have been because one or both of the parents usually accompanied the children to and from school each term and special mid-term parents' weekends were also arranged to strengthen their direct contact. St. Margaret's has four terms in the year with holidays of 12-13 weeks in all, and the next opportunity when parents could be encouraged to see the Headmistress personally would never be far distant.

Another factor also operated as a safeguard against intruding into the province of the school. Though it might have eased some of the interviews, it was decided to make no attempt really to get to know the children personally and directly. It seemed that, under the conditions of this study, the children could gain nothing from another addition to the complex of personal relationships already existing with the school staff and embracing their "home" care, teaching, the various forms of therapy, medical care and hospital and consultant contacts. It seemed essential, however, to be able to visualise each of them when visiting their homes as well as to draw on the knowledge gleaned from records and verbal reports. The plan adopted was, therefore, to see and observe the children unobtrusively and visits to the schoolrooms were found to be a good way of identifying the children without singling them out from their groups.

The Children

Before passing on to the material from parents' interviews, certain things should perhaps be said about the children who were, after all, the reason for the study, and who were, in fact, a highly selected group.

Numbers—Of the 38 children on the original list, two left school before the field work was started, and in three cases no reply came to the invitation to co-operate. One home was ruled out for reasons of distance and, owing to special circumstances, it proved impossible to arrange contact with one other family. This left a group of 31 children, which was found to consist of 18 girls and 13 boys. Five of them were day-pupils. Two were adopted children.

Ages—The children's ages, at the time of contact with their homes, ranged from a little over 8 years to over 15 years, distributed as follows:—

Age years	*Boys*	*Girls*	*Total*
8— 9	3	1	4
9—10	1	3	4
10—11	5	3	8
11—12	1	3	4
12—13	3	2	5
13—14	—	4	4
14—15	—	2	2
	13	18	31

It appeared to be quite fortuitous that the boys were both a smaller and a younger group than the girls. The length of time they had so far spent in the school is shown below:—

Years at school	*Boys*	*Girls*	*Total*
Under 1	3	—	3
1—2	3	3	6
2—4	3	3	6
4—6	2	7	9
Over 6	2	5	7
	13	18	31

Selection—The children at St. Margaret's had all passed through a most careful process of selection, since there has always been great pressure for the available places. "Screening" interviews take place at the school and are arranged as soon as possible after receiving applications which seem suitable on paper. Both children and parents are seen by the school's physical medicine and pædiatric

consultants, and psychological tests are carried out with the children. The extent of the child's handicap and his relative chance of progress at home or at school is fully considered. The decision about acceptance (always probationary) is then based on the double criteria of adequate intelligence and a personality capable of making an effective drive towards improvement in relation to the existing disability, as well as on a real need for the special training facilities of the school.

The parents had without doubt been greatly encouraged and helped by the screening interviews in spite of the very considerable period which many had afterwards waited for vacancies to arise. Sometimes, indeed, the full consultations helped in a practical way to secure suitable treatment and educational provision for the child during the period of waiting until admission was possible. In fact, the period between acceptance and admission shown below was alleviated in most cases by the help they received in their own homes or at school before admission.

Period between acceptance and admission
Day pupils

1	admitted	within	1 month	in 1948
1	„	„	6 months	in 1950
1	„	„	12 months	in 1952
1	„	„	18 months	in 1953
1	„	„	2 years	in 1954

Total 5

Boarding Pupils:

Waiting period	Year of admission 1947	1949	1950	1951	1952	1953	1954	1955	1956	Total
Under 12 months	1	2	1	—	1	—	—	—	—	5
12 to 18 months	—	—	1	1	4	1	—	—	—	7
18 months to 2 years	—	—	—	—	1	2	2	1	—	6
2 to 3 years	—	—	—	—	—	—	2	3	3	8
	1	2	2	1	6	3	4	4	3	26

Help available before admission to St. Margaret's

Two-thirds of the children had treatment first in the form of physiotherapy, either in their own homes or through outpatient attendance at Clinics or Hospitals.

Twelve had been away from home in residential care at some time: 4 as hospital inpatients at a C.P. unit; 3 as hospital inpatients for short-term care or orthopædic treatment; 2 in "chronic" cripples' hospitals; 4 in residential schools or homes.

(One child had been in both a C.P. unit and a residential school.)

The children whose education was provided for before their arrival at St. Margaret's were dealt with as follows:

Ordinary day schools (including private schools)	7
Day schools for physically handicapped (including hospital and C.P. school) ...	5
Residential schools	2
Home teacher	8
P.N.E.U. home-study scheme...	1
Total:	23

Speech therapy was made available by the L.E.A. in five instances.

The probationary period—The first term at school, and sometimes the second term also, were regarded as a probationary period, during which the child had been accepted provisionally only. This was eminently reasonable, and so was the school's reservation of the right to ask for a child's withdrawal at any time if progress did not justify his retention. Nevertheless, anxious parents who may

have waited a long time for a vacancy found this uncertainty extremely hard to bear, and often what might seem foolish lack of co-operation and unhelpful pressure on the children during this period was due to the importance they attached to his keeping his "chance".

Emotional problems—After allowing time for the children to settle down and for the staff to get to know them, those who appeared to need psychiatric help were being seen regularly at the school by a visiting psychiatrist. Nine of the children whose histories were studied were included in these arrangements. It was, however, a severe handicap that the parents were not usually accessible with any regularity. All that was possible in this connection were sporadic contacts whose patchy effect was clearly shown in the imperfect acceptance and understanding of this service on the part of the parents.

Arising out of the last paragraphs, a comment may perhaps be in place here. One wonders how far help could be given by a regular personal link with the homes of the children during the time they wait between acceptance and admission and through the first school year. Certain difficulties might thereby be avoided, and such a service could be extended quite naturally if and when psychiatric help was needed.

The Children's Families

Home interviews—Once personal contact was made and doubts about the purpose of the visit cleared up, the parents' co-operation was most readily given. They accepted the idea that there might be some value in pooling their experiences, and most of them were able to be helpfully objective. It was encouraging also that spontaneous comments were so eagerly forthcoming during discussion on existing provisions for children with cerebral palsy and how far these met the needs of the situation. At the same time, alongside such general considerations, the individual emotional experience for the parents was often vividly illuminated by their account of the child's history.

Unfortunately, not even weekend or evening visits made it possible to see both parents in more than a few families. In several other homes it appeared that there would have been no real difficulty for the father to be present, and one could only conclude that sometimes at least they did not wish to take part in the discussion. Other members of the families were occasionally seen, but the mother's point of view will obviously be predominant in the following general picture of the experiences and anxieties common to parents with cerebral palsied children, as found by this group.

The frank discussions which took place with the parents high-lighted the issues which had special significance for them in their efforts to tackle the situation and their outlook on it.

Early anxieties—In only 12 instances were anxiety-provoking circumstances entirely absent during pregnancy, and in only four of these was there still no cause for anxiety after the confinement; 13 children were born prematurely, and four later than the normal term.

Adding to these considerations the fact that so many of the group were first children, the vast majority of the mothers were certainly predisposed to doubt about producing a healthy child before any developmental difficulties appeared. Many of them recognised afterwards that this was so, and questioned what effect their "set" towards worry throughout the early months might have had on the child.

There were too many other complicating factors for comparison to be possible on this point between those with first children, and those who already had a healthy older child. The latter were naturally better equipped to question faulty or delayed development, and were, in fact, the first to do so. Perhaps also

their experience heightened their anxiety; one had the impression, at least, that it was very acute and adversely affected everyone concerned.

There seems little doubt that, except where there were *obvious* physical defects or difficulties, the overwhelming anxiety was lest the child should prove to be mentally defective, and that this nagging worry opened up all the possibilities of tension, suspicion and recrimination between the parents, and the feelings of guilt and failure on the part of the mother, which are inseparable from such an event.

The search for help—The age at which the parents first sought help over developmental difficulties varied from five or six months to as late as 21 months, but a large majority (23 out of the group of 31) took steps in the matter when the child was between 9 and 15 months.

17 families turned first to the maternity and child welfare clinics, three also consulting the family doctor at the same time. Six others sought specialist help via their own doctor, and seven went direct to hospitals (usually when the children had been born there).

The effect of an unimaginative reception of their anxious and often tentative approach will be mentioned later. It is impossible to determine, but one wonders whether this might sometimes have reinforced the parents' natural tendency to take up the cudgels on behalf of the child, and helped to create resentment against the "authorities" who have to be fought to convince them of the needs of the situation. Such an attitude was, or had been, present in at least a third of this group of families.

The fact that the search for help was sometimes long drawn out was inevitable; repeated examinations did, however, lead to special problems with some of the children themselves and a general state of jumpy suspense in the family while the parents nursed their hopes that medical skill or a miracle would set matters right.

Learning and facing the facts—By the age of fifteen months, when 25 families had sought help, an actual diagnosis of cerebral palsy had been given to the parents in only five instances.

By two years, when all had been examined, only 10 families had learnt the child's true condition. (This may have been determined in other cases also, though not explained to the parents). All but four of the children had been diagnosed as cases of cerebral palsy by the age of four years.

An extra load of mental stress was unhappily placed on some families by an earlier diagnosis of mental deficiency, or what they took to be the equivalent. In ten instances they had been told at some stage in their consultations that the child was "M.D.", "ineducable", "a hopeless case", or "would never be any good". Even when the parents later gathered confidence from their own observations that the experts were mistaken in this aspect of the matter, it usually made their "fight with the authorities" for suitable help harder and longer.

Generally speaking, arrangements for some form of treatment went along with the determination of the child's condition, and all but three of the children were receiving help before they were five.

Full and constructive acceptance of the diagnosis obviously needs time to achieve, and the family histories bear this out completely. Perhaps no one would have claimed that their adjustment was over, but half the families appeared to have faced the situation successfully in a way that was helpful to the child and with a sturdy prospect for the future. In the other half, acceptance so far had been less successful and was still evidently not complete. (In this connection the two adopted children and one other case which was not fully comparable were omitted, so that the whole group under

consideration was reduced to 28). The two halves of the group showed no general difference in present ages, nor, surprisingly, in their success in getting early help, nor in their need to fight for a satisfactory solution for the child. The less successful half included three times as many "only" children, though it must be added that there were adverse circumstances other than the C.P. problem, such as parents' health worries, which affected these families also.

It hardly needs stating that the acceptance these families were called upon to make was no easy thing. Like those with a mental defective, they were families thrown out of gear by a child's failure to develop properly, and in this case with disabilities of such a character that heavy physical burdens usually accompanied the emotional stress. Some parents felt that the physical burden, and their own resulting exhaustion had in a curious way helped them by subduing and distracting them from anxiety, though it might have delayed their emotional acceptance.

The family's problem—The general family problem is many-sided: there is the problem of the handicapped child himself and his own needs, that of the parents separately and together, that of brothers and sisters, and that of the family as a whole. In a study of family backgrounds, it seems appropriate to start with the last.

Out of 28 children, 22 were the first child in their family. (Five had been preceded by at least one unsuccessful pregnancy: in one case a twin had been born dead). 12 of these first children remained only children; the other parents added to their families after intervals ranging from 2 to 7 years.

There were four C.P. children who came second in their family; in two cases no other children followed, and the remaining two families had one younger child each, after intervals of 2 years and 5 years.

The one C.P. child who came third and the one who came fourth were both the youngest of their family after intervals of 13 and 7 years respectively.

Some of the mothers who had decided, in spite of misgivings, not to limit their family to the first C.P. child offered most interesting comments. They all attached very great value to this decision, which seems to have been a relief in itself, especially where it had been made jointly by both parents. One mother who "persuaded" her husband spoke of the intense anxiety which she felt she could not share with him during the second pregnancy, but she was just as fervent as the others in her final feeling of release and achievement. They were all most anxious to express how strengthening and restoring it had been for the whole family once they had produced a healthy second child, and acquired a much needed perspective.

From the figures quoted above it seems that many parents deliberately chose to restrict the family unit. This might seem a likely way of reducing the impact of the problem, but in some ways it results in intensifying it since it closes the small circle consisting of parents and handicapped child. These parents frequently expressed their hurt at their relative isolation from the normal stream of life, their loss of the ordinary contacts common to parents of active school children, the loss of companionship for the child. Some referred to the feeling of ostracism, which they had experienced in various ways, because of the child's condition. It had obviously taken courage, for instance, to continue attending a clinic, or take a child regularly to an infants' school so that he should have the fair trial they had fought for, in the face of opposition from other parents, and even at times from members of the school staff. All the parents suffered the physical difficulties of keeping in touch with friends and relations who had to be visited, and the discouragements if the

child was not always a welcome visitor in spite of their efforts. Some felt cut off from attendance at church, and though few complained of being tied to their home, it was evident that some of them sensed a resulting impoverishment which they had hard work to avoid without outside contacts. The sheer physical weariness of looking after a C.P. child, sometimes with unsuitable housing conditions, was an additional drain on their energies.

If the life of the family unit with a C.P. child is to be successful, the parents clearly need to be in harmony. The extent to which this was so in the group of families considered could not be assessed reliably with the incomplete contacts, but it seemed that, in those families who had faced the situation successfully, harmonious and mutually supportive relationships were in the large majority, whilst they were more doubtful in the others.

To meet the needs of a C.P. child at home cannot be anything but an individual matter. The parents' problems vary according to his physical handicap (with sensory defects), his personality and his disposition. They also change as he grows, and as his experience of life influences his ideas and general attitude. Consequently, it may be of little value to look at the group of homes as a whole in this connection, though a few general observations may be worth while.

Generally speaking, when expert advice had been obtained, the parents adjusted to the physical problem without much difficulty even when the child was helpless or very severely handicapped. Sometimes they experienced difficulty in getting helpful equipment but many fathers came to the rescue in designing and constructing practical aids.

Understanding and helping the child as a growing personality was by far the larger problem in most homes, and the parents were well aware of this. In a few instances, where the parents themselves had unresolved personal problems, the emotional difficulties which the children showed might well have occurred with any non-handicapped child in the home, and, in fact, sometimes did. There were six or possibly seven instances of this amongst the 29 "natural" families. But apart from these, most parents recognised that the child's emotional struggles determined directly by his condition were a challenge to their wisdom in dealing with him. Questionings over the reason for his condition; hopes and fears for the future; depression, outbursts and distress associated with physical frustrations were brought up for discussion in 19 homes, and implicit in some of the other parents' anxieties for the future.

Easy excitability was mentioned by 12 of the parents as a difficult complication in handling the children at home. In one case, a problem of jealousy on the part of a younger child, due to inevitable differences in handling the C.P. older child, was making the parents' task far more tricky during St. Margaret's School holidays. Over-protection on the part of the parents is very difficult to assess with children needing so much care, but it was clearly recognisable in four homes, three of which had only children. In another home the parents recognised that their other children were increasing the child's dependence by over-solicitude, and in one other instance they attributed excessive dependence to over-helpful friends at her first day school.

It was interesting that 14 of the children were described as having a definite bias towards activity or adventure; one of these seemed to get a special satisfaction from speed, and the others sought every chance to follow active pursuits like football, digging, etc. Two children had noticeably less initiative now than formerly, perhaps as a result of extreme discouragement over their progress. Only nine in all appeared entirely satisfied with passive interests, and four of these

seemed to have withdrawn into this state for fear of "doing wrong", falling, or making themselves conspicuous by clumsy movements.

Other children in the family with a C.P. sibling have to face with their contemporaries some of the same problems as their parents, and there was evidence in three cases at least of difficulty for the brother or sister. Children's attitudes tend rather to curiosity and taunting than ostracism, and the parents naturally have to be protectors to all their children. How far they can do this and secure a satisfactory childhood for their non-handicapped children, as well as focus on the C.P. problem itself depends very much on the personality of the parents. In a large majority (about two-thirds) of the homes with other children, the parents seemed to be meeting the needs of the different members of the family successfully. The tendency to over solicitousness shown with many of the only children hardly affected these homes, and there was no evidence of jealousy or antagonism to the C.P. child on the part of the siblings.

The two adopted children—It was interesting to find amongst the group of children two who had been adopted in infancy. Whilst being obliged to set them aside when considering different aspects of the family problems, they merit some separate comment.

It appeared that both children were puny, though they seemed normal and healthy, when taken by the adoptive parents, who for that reason were moved to lavish special care on them. In both cases specialist advice was sought early, and the frustrations common to the other parents experienced, together with the peculiar bitterness of having adopted a child who was severely handicapped. Both "mothers" appear to have overcome this successfully in their different ways, and their observations from a standpoint of more detached affection have some special value.

In their estimation the points of major importance to parents are:

1. Acceptance of the real handicap.
2. The problem of dealing with the frustrated child, who is being deprived by his handicap of normal experiences.
3. Understanding that the achievement of walking may be secondary in importance for the child to the use of hands or brain.
4. Consideration of pros and cons of home teaching, day school and boarding school provision.

General Experiences of the Parents

Returning to the general human problems surrounding children with cerebral palsy, the following observations arise from the experiences of this group.

In the pre-natal period, because of experiences in earlier pregnancies, some mothers developed more than ordinary fears for the health and perfection of the child and their own successful maternity. Such fears might be reinforced by premature birth, or by circumstances at the confinement itself, and might be made acute where the child's survival seemed threatened by breathing or feeding difficulties. If these hurdles were once safely surmounted, there might still be no respite from anxiety if screaming and sleep disturbances arose, though in many cases parents gained a short interlude of less pressing worry. As time passed, however, and the children failed in one or other way to follow the expected pattern of development, or showed visible defects, such as a squint, the parents' worries returned with redoubled force.

Amongst the group there was considerable variation in the age at which they sought help for the child and the extent to which parents bottled up their mounting anxiety, often concealing it also from each other. Many, who first expressed their worries at the infant welfare clinics,

hesitated for some time before doing so, for their own individual reasons. Some feared being regarded as unnecessarily fussy over their first child; others dreaded confirmation of their own fears that the child might be mentally defective. Unhappily some, by their reception, were discouraged from renewing their plea for advice for a considerable time. The fact that they were deeply distressed, whether or not there was adequate cause, very seldom brought them help in their own right, and injunctions "not to worry" over a child who was merely "lazy" had, as might be expected, no effect at all. At a rather later stage, many of the experiences related by the parents in connection with Hospital consultations showed a similar lack of recognition on the part of the Hospital that in bringing their child for help they were themselves people in need of sensitive understanding, and were emotionally very vulnerable.

Not many of the parents appeared to have had satisfying support (except where they got it from each other) through the difficult process of facing the fact that they had a damaged child. What this realisation meant to the parents, particularly to the mothers, and how deep the mental stress it aroused, obviously varied according to the personalities concerned. Their inner acceptance could never be a momentary thing, but only a hard-won achievement which might take years to complete. There was no doubt, however, that at this period the parents' own need to come to terms with the practical situation was paramount, and that meeting this need must include both dealing with the physical problem as such and with its implications for the whole family.

A few had been specially fortunate in the way in which the diagnosis of cerebral palsy was conveyed to them, and had been given understanding of the difficulties lying before them and the child, together with the hope of whatever help was available through treatment and education, but many others felt they had been left to face and find out everything for themselves and battle unaided with "the authorities" to get help of any kind.

With each child there comes the poignant stage, dreaded by the parents, when he himself must realise his condition and begin to face his problems. Till then, the parents alone have carried the emotional stress, but they know they will eventually have to accept the difficult task of standing by while he grapples with his own inevitable emotional problem over and over again. At this point, there seems to be a desperate need for something active and practical which can be done for the child to relieve frustration all round. Home exercises, physiotherapy, speech therapy, home teaching were all much appreciated, perhaps most of all when they were the means of bringing into the situation a knowledgeable and sympathetic person from outside who could help to relieve the charged atmosphere of the home.

This group of parents all eventually found a niche for the child at St. Margaret's, though mostly after a long waiting period. This wait was often considerable before screening, as well as after, and the total delay sometimes equally difficult to tolerate for both child and parents: the child "champing" to get on, and the parents who saw the loss of time as tragic for his progress. Though often alleviated by other means, as already mentioned, the parents' anxieties appeared to build up again at this point, with tension and pressure on the child at their height during his trial terms.

How the parents feel they could be helped

No attempt is being made here to review or evaluate the services available for cerebral palsied children, but merely to bring together some comments and suggestions made by different parents.

Some have encountered special difficulties when they have had inconsistent

advice on treatment or home handling from different centres at different times. Whilst recognising that there are many independent workers, each with their own point of view, they are naturally anxious to know where they are and not to have the children confused.

1. Parents feel that it would be of great assistance if at the time the child's condition was determined they could have personal help with reliable information on:—

(a) The condition itself.
(b) What expectation of achievement is reasonable both physically and educationally.
(c) What equipment might help, and how and where to get it.
(d) Where suitable educational facilities exist.
(e) Within the limits of progress expected, what possibilities the future will hold.

2. They realise that assessment of the child's capacity to profit from treatment and education is essential in order to get suitable placement, but is very difficult to make.

3. They would like to discuss with an educational adviser in their home area the pros and cons of home-teaching, day school or boarding school provision, in relation both to education and treatment available. They have reservations about the employment as visiting teachers of people beyond the normal retiring age and without special experience or equipment.

4. They would like to know more of the effect of treatment involving physical restrictions on the child's total outlook.

5. With a child at boarding school they would like help to understand the regime, especially the balance between treatment and education and how they can further both during the school holidays.

Finally, looking over these comments, the parents' chief need seems to emerge as the possibility of unhurried discussion of their problems with knowledgeable people at various stages, whilst close co-operation between everyone dealing with children suffering from cerebral palsy would naturally overcome many of the difficulties they have expressed.

Beyond his treatment and education, the parents' major concerns are for the child's present happiness and his future niche in the world. Such matters as the desirability of day or boarding school were questioned by thoughtful parents, several of whom had found the decision to let the child go away from home very difficult.

Later on, an expert consultation might have helped in some cases where progress had been disappointing and the parents needed to set their sights more realistically. However well they are facing the facts at home, it is difficult for them not to overrate the powers of the school to equip the children for life afterwards. One parent who wished to know what was being done to "open up horizons" for the children appeared to be feeling after two things—the practical opportunities for earning, and the intellectual resources which could make a passive life more tolerable. This is a most important issue: the probability that many severely handicapped children will need to accept limited success in employment makes it vital that intellectual and other satisfactions should be developed to the full. The harmony of the family may depend on bringing about a happy adjustment of their handicapped member by these means, but the school alone cannot accomplish it. Each child faces his own unique situation and must be helped at home, no less than by all the special services whose co-operation is called for, with imaginative understanding of the possible horizons towards which he can reach out hopefully.

ELECTROENCEPHALOGRAPHY IN CEREBRAL PALSY

AT THE beginning of this century, the function of the central nervous system (CNS) in relation to motor activities seemed to be logically explained. The brain in particular appeared to have a number of compartments (or centres) where various functions were elaborated or somehow represented. Anatomo-clinical terminology with the usual sprinkle of Greek and Latin took the lead and the abnormal conditions were classified accordingly. "Pyramidal" and "extrapyramidal", "cortical", "striatal", and "cerebellar", among others, represent the heredity of a terminology which adapted clinico-pathological observations to retrospective speculations about the function of the CNS.

It is only in the last few decades that the neurological study of head injuries from a variety of accidental approaches, neurosurgery with a number of systematic interferences, and neurophysiology with various measurements whose significance is still obscure have shown how little we do know about the CNS in relation to motor functions.

The study of cerebral activity with electrical recording apparatus began a long time ago. But it is only in the last few years that electroencephalography (EEG) has become an established method of investigation in many neurological and pædiatric centres. The fluctuations in differences of electrical potential that occur almost continuously between various regions of the brain are probably related to the continuously changing biochemical and biophysical properties of the nervous tissue. The relationship between the "brain waves" recorded and the mode of operation of the CNS in terms of sensation, its elaboration, and the ensuing motor impulses is not yet understood. However, it is known that changes in the electrical activity of the brain are somehow related to disorder of function, or even to structural alteration, within the CNS. From a study of the deviations from the normal in a large number of patients whose diagnosis was known it has been possible to establish the clinical and anatomical correlations of certain alterations in the EEG. At present extensive and accurate clinico-anatomical observations in cases of "cerebral palsy" are lacking (with the exception of hemiplegic patients) and their correlation with EEG studies is therefore still extremely limited.

The study of the electrical activity of the brain should be considered at the same level of importance as the study of other physical signs. Like other ancillary methods of investigation in medicine, the EEG has a precise but limited application.

A number of papers have been published on the EEG findings in "cerebral palsy" in relation to:

(a) The main clinical features (hemiplegia, diplegia, athetosis).
(b) The presence or absence of seizures.
(c) The suspected ætiology (infection, paranatal insult, prematurity).
(d) The neuroradiological findings.

There is a considerable margin of agreement on the following points:

1. Asymmetry between the electrical activities of the two cerebral hemispheres is more common in hemiplegic patients than in the other groups.
2. Focal and generalised EEG abnormalities with frequent discharges are recognisable in most patients who have

seizures, and such abnormalities are much less common in patients without seizures. Cases have been reported in which seizures began some weeks or months after the appearance of discharges in the EEG.

3. About a third of all "cerebral palsy" patients do not show any gross EEG abnormalities, and some abnormal features are said to be more common in spastics than in athetoids.
4. The proportion of abnormal EEGs is smaller in patients whose "cerebral palsy" is ascribed mainly to prematurity or anoxia than in those who had a known cerebral injury or infection.

There is some discrepancy between the type and extent of neuroradiological abnormalities and EEG abnormalities, but this is understandable because the two methods measure different things. No adequate combined clinical and EEG follow-up studies have yet been published to assess the possible prognostic value of EEG abnormalities found at an early age in relation to the subsequent development of neurological disabilities. However, the next few years should see the completion of some of the work now in progress.

In "cerebral palsy", and in several other conditions in which the CNS seems to be altered in some obscure way, the EEG can only assess within the limitations of our present knowledge how a given patient's brain seems to work—whether it responds normally to various stimuli (including, if necessary, stresses and drugs); whether there are gross differences in the functions of the two cerebral hemispheres or of particular areas of the brain; whether discharges are seen of a kind commonly observed in patients who have seizures and where such discharges appear to arise in the brain; in what conditions patterns are seen similar to those recorded in our patient; and whether our clinical impression of that patient's condition is supported by, compatible with, or incompatible with the EEG findings. This method of reasoning is applicable to the evaluation of any physical sign in medicine, and EEG is no exception.

Judging from the published work and from personal experience, electroencephalography does not seem to have any particular diagnostic or prognostic potentialities in "cerebral palsy" beyond those it might have in any neurological disorders often associated with cerebral anatomical and functional abnormalities. including seizures. The main disadvantage is that we know too little about the causes and anatomical substrata of those many conditions arising early in life which, for the sake of administrative convenience, are still grouped under the term "cerebral palsy".

G. PAMPIGLIONE

BOOKS—New and Not So New

CEREBRAL PALSY IN CHILDHOOD. Grace E. Woods, M.D., D.P.H., D.C.H. Bristol: John Wright & Sons, 1957, *pp.* 158+*xii, with* 21 *plates.* 27*s.* 6*d.*

This is an interesting book to read and it stimulated me to think hard. Its approach is that of a children's doctor trying to assess fully the child with cerebral palsy so as to plan the management and treatment. In his foreword, Dr. Peter Henderson, Principal Medical Officer, Ministry of Education, describes it as "a first-rate clinical study, undertaken with insight and patience." It reports the conclusions of Dr. Grace Woods, a school doctor at Bristol, after observations made on school children and pre-school children over some 14 years. It does not go in any detail into physiotherapy or educational therapy.

Dr. Woods defines infantile cerebral palsy as including "all cases where there is an upset of the normal pattern of movement due to a cerebral cause". I would prefer a definition which did not include progressive disorders—e.g., from cerebral tumour. The American Academy of Cerebral Palsy revised its earlier definition to leave them out. Incidentally, why leave in motor disorders resulting from spinal conditions (e.g. Friedrich's ataxia)? They are out of place and give an impression of untidiness.

The cerebral palsies are described under seven headings: paraplegia, monoplegia, hemiplegia, quadruplegia, athetosis, ataxia, and rigidity. This is not very logical. For the first four the cases are grouped by the distribution of the palsy; for the last three by clinical findings. Four cases of hemiathetosis are put with the hemiplegias; they are such a rare sort of hemiplegia that they might have been better with the other cases of athetosis.

The reader who goes to the book to learn from Dr. Wood's experience how he may recognise and classify his cases may, like me, be cast down to read that "these cases can only be assessed by a personal appreciation of the movement upset and not, as will be shown later, by set clinical signs". Why do I find this (and all other) appeals to "personal impressions" and "intuition" so depressing? Let me try to explain something which seems important to me as a teacher. Everyone uses "clinical impressions" but they are to be treated as hypotheses or guesses to be confirmed. They are based (if not on a knowledge of the history) on observed data, and such observations are surely of physical signs? If an experienced person is to convey his knowledge, to make his experience useful to others, he must state the grounds on which his judgment is made—i.e., the observed data he has used. This is not to deny that experience and judgment come into the assessment of physical findings—whether a sign is positive or not—and their significance.

A review of the history and literature of cerebral palsy follows. The main historical papers are summarised; more recent work is not very fully dealt with.

In "The Clinical Examination", the neurologists of adults may be surprised that the estimation of tone is dismissed as not worth attempting. Many of us would agree that examination of the tendon reflexes "is not very helpful" and "The plantar reflex (is) of doubtful value" but this makes us study the other signs—tone, posture, coordination—all the more carefully.

Seven chapters follow dealing with the seven types mentioned above. Was it necessary to have a chapter on "Monoplegia"? In all Dr. Wood's cases the movement upset was slight and involved the leg and foot. I believe that on examination in early childhood, and usually when carefully examined later, signs of paresis can be discovered in the upper limb of the same side. In other words, these are hemiplegias, just as paraplegias are, in most cases, diplegias of a particular degree.

Under "Hemiplegia" Dr. Woods makes little reference to stunting of growth. She makes illuminating and valuable comments on the associated movements often seen in the affected limb when the opposite one makes a vigorous effort, and points out that these movements can be a serious handicap to the child.

Of the 95 cases of hemiplegia, 4 were examples of hemiathetosis. Another group had marked sensory loss combined with minimal spasticity, the sensory loss being astereognosis and loss of position sense. Dr. Woods wonders whether in some of these there was apraxia rather than true spasticity. In a third sub-group of hemiplegias there was minimal spasticity but a refusal to use the limb which it is suggested might arise from a defect of body image. Cerebral damage during the birth process seems to be an important cause of hemiplegia but there was very little evidence of unskilled midwifery.

A chapter on "Quadriplegia"—by which Dr. Wood's means *spastic* quadriplegia—starts by saying that this is the type called Little's disease. Since Little's original paper described cases with athetoid movements, the term Little's disease should surely cover athetoid cerebral palsy as well as the bilateral spastic disorders. But as some use "Little's disease" only for cases due to birth trauma, an eponym may once again have to be discarded.

In the chapter headed "Athetosis", where athetoid cerebral palsy is described, I would quarrel with the remark that the child's body passes into a state of "slow" muscular contraction. Some of the unwanted movements are certainly slow, but many others, even those of the whole trunk, are quick. The persistence of tonic neck reflexes in athetoid cerebral palsy is emphasised by Dr. Woods. I would not agree that *all* athetoid children show remains of the tonic neck reflexes, but this is an extremely interesting point.

I am pulled up short by the reference to an "ataxic athetosis" (described by Perlstein and Phelps), which combines defective upward movement of the eyes and high-frequency deafness. This ataxia is not defined here, and in the chapter on "Ataxia" Dr. Woods decides that ataxia refers to movement disorder in the absence of spasticity or athetosis.

Ataxia, it seems to me, is a word we must use with great care, and the chapter on "Ataxia" is appealing because it reveals some of the problems which Dr. Woods has met in classification. She points out that the full cerebellar syndrome is rare and that the ataxias we see may arise from the cerebral cortex or may in fact be apraxias. To define ataxia as "inability to direct normally initiated motion" (Phelps' definition) is too wide; but Dr. Woods greatly improves this definition by saying that this inability must not be associated with spasticity or flaccidity. She also says, "in this chapter it is proposed to discuss all the odd types of cerebral palsy which do not demonstrate spasticity or athetosis, but which have a definite cerebral palsy of an incoordinated type". In other words, the group of ataxias is to include a variety of different types. The case-histories in this chapter are tantalising. One would dearly like to see these cases and discuss them with Dr. Woods.

There follows a chapter on "Rigidity". A footnote remarks that "severe cases of

spastic quadriplegia, when awake, lie in bed fully extended, often with scissors formation of the legs." I think this is true of little children but not of older bilateral spastics who often develop flexion at knees and hips. Probably Dr. Woods is referring to (decerebrate) rigidity as a phase in the evolution of a case. Although rigidity is not defined, it seems here to include some stiff athetoids and some stiff spastics.

There is a chapter on "Visual Defects", another on "Auditory and Speech Defects", and another on "Sensory Defects". This last is a specially interesting subject. That a defect in body-image may possibly cause the troubles of some children with an incoordinated walk and bizarre movements is another of the lively ideas put forward. To imply that finger agnosia is the same as Gerstmann's syndrome is misleading. Finger agnosia is an important sign but it should have been remarked here that not until they are 17 or 18 years old do 100% of normal children show full knowledge of which of their middle three fingers is being touched. The results of tests under this age have to be interpreted with care. Nevertheless, in a small pilot study I found that if, in a cerebral palsy school, you find which children have had a special difficulty in learning (1) to use their fingers; (2) to tell right from left; (3) to calculate; and (4) to write, then you can identify certain children as having a type of learning difficulty which may not have been recognised by their teachers. Gerstmann's syndrome may be important; for the benefit of the pædiatrician or school medical officer who may be meeting it for the first time here it should have been referred to accurately.

There is a chapter on "Epilepsy" and a final chapter on the "Assessment of Educability", which should stimulate us all to a closer study. Educability is perhaps the pressing problem in the assessment of children with cerebral palsy.

The illustrations form a valuable complement to the text. The book is well produced. There are few errors. Dr. Worster-Drought's name is twice wrongly spelt; on page 84, line 12, "Fig. 31" should read "Fig. 30"; on page 79, line 1, "mild spastic child" should surely read "mildly spastic child"? To describe athetosis as "abnormal movement defect" (page 74) is tautological.

The book will be of great interest to anyone who has any experience of cerebral palsy. The neurology is certainly better than in the last book I read on cerebral palsy but it could do with tightening and clarifying of definitions.

I very much hope that Dr. Woods will revise this book, which, although it still bears rather obviously the marks of having been a thesis, is the most stimulating book I have read on cerebral palsy. I look forward to the next edition.

R. C. MAC KEITH

PRIMER OF CEREBRAL PALSY. Joseph D. Russ and Hyman R. Soboloff. American Lecture Series. *Oxford*: *Blackwell Scientific Publications*, 1958, *pp.* 77. *Illustrated.* £1 10*s.*

This book is by members of the medical teams of the cerebral palsy centres of Greater New Orleans and the Louisiana State Cerebral Palsy Centre. It reviews classification, ætiology, diagnosis, the cerebral palsy team, therapy, psychometric evaluation, prognosis (an especially good chapter this), special education, final aims, relationships and needs, and gives a bibliograpy of about 100 papers published in 1951-56. The work supplies a good brief general survey and emphasises the value of having a long-term aim (modified later if need be) for each child.

The classification adopted (Minear, V.L. *Pediatrics*, 1956, **18**, 843) is the one accepted by the American Academy of Cerebral Palsy and endorsed by the American Academy of Pediatrics. The A.A.C.P. wisely decided to omit palsy due

to cerebral neoplasms and other progressive disorders. It is a pity that the authors have not also discarded motor disorders due to vascular accidents in adults. Do the "aged adults" (p. 20) with hemiplegia attend the Louisiana State Cerebral Palsy Centre? A more cogent reason for excluding such late lesions is that the characteristics of cerebral palsy cases as a group largely depend on the lesion having occurred before the completion of development.

For the complete description of a cerebral palsied child we are told that "the following categories should be listed."

A. Motor symptoms
B. Topographic involvement
C. Ætiology
D. Anatomical site of brain lesion (if possible)
E. Severity of involvement
F. Degree of muscle tone
G. Supplemental data

This, then, is a classification based on clinical findings; and wisely so, for we cannot yet put anatomical or ætiological labels on most cases. Seven types of motor symptoms are listed. Under "Rigidity" the important point is made that in *spasticity* the resistance to movement at a joint is greater in one direction than in the other, whereas in *rigidity*—whether lead-pipe or cogwheel—there is resistance to movement in both directions.

The adults' neurologists in this country (and probably in the U.S.A. too) will regret that bilaterally affected cases are called quadriplegics (or tetraplegics), for to them quadriplegia implies a spinal origin of the palsy. Nor does this term indicate whether a spastic "tetraplegia" is worse in the upper or the lower limbs (nor does category E give this information). However, the useful topographical terms "diplegia" and "double hemiplegia" are apparently permitted, for they are given.

Under "Ætiology" we are told: "There is no definite correlation between the physical and mental signs and symptoms and the amount and location of pathology demonstrated upon autopsy". Some of what we know to be usually true is then cited. But when it is stated that "damage to the cerebellum . . . is instrumental in producing poor muscle tone" one would like a reference. It seems too sweeping to say, apparently of cerebral palsy in general, that "the cause of this damage has been basically either anoxia or cerebral hæmorrhage", for this might be taken to imply that cerebral palsy is "basically" due to birth injury. Whereas birth injury occurs in only about half the cases of cerebral palsy.

Chapter III deals with "Diagnosis" and three basic types of cerebral palsy: (A) spastics; (B) dyskinesia (athetosis, tremor, rigidity); and (C) ataxia. This is a departure from the "authorised version" of Minear and the academies, but it is a sensible contribution to simplicity and in some variant is likely to find its way into the classification in use in 10 years' time.

It is at present the fashion to say that "the eliciting of the stretch reflex is the primary diagnostic sign of spasticity". (The authors mean an *exaggerated* stretch reflex; normal muscles show a stretch reflex.) In saying this we are perhaps too docilely following observations made on adults. There are at least two common exceptions in children. One is the severe spastic diplegia with firmly adducted and stiffly extended lower limbs, for they can not be manipulated. Another is in the groups of hemiplegias which have no increased tendon reflexes or manually elicited stretch reflex, and yet the presence of hypertonus is evident from the steady contraction and later contracture of the plantar flexors of the ankle.

One would have welcomed a more exact description of how the neophyte is to tackle the examination and classification of his cases. However, this is an essay, rather than a beginner's guide.

The later chapters (the titles have been mentioned above) give in 40 pages an

excellent general review of management, therapy and prognosis. There are no details of physiotherapy but a great deal of wisdom.

The book is beautifully produced and printed on glossy paper. There are a few printing errors: numbed for number (p. 17); distonic for dystonic (p. 23); Kirkman for Kirman (p. 71); and scarification for scarring (p. 11). There is too casual a use of words without due consideration of their meaning. "Lesion" is used for the cause of damage as well as for the damage. When the authors say "mixed lesions" on p. 11 they mean "lesions with more than one agent of damage". They speak on p. 24 of "overflow of involuntary activity"; but what happens is an (involuntary) overflow of voluntary activity. When they say "a suspicious baby" they mean a suspected baby. On p. 23 they refer to "several types of athetosis, such as tension, dystonic, tremor, flail and rigid". The A.A.C.P. has not accepted Phelps' flail athetosis, so in a short review it might have been omitted; and a "rigid" athetosis is not among even Phelps' twelve varieties. The authors are confusing athetosis as a movement (on p. 4 they have defined it as "uncontrolled etc. *motions*") with athetosis as a type of cerebral palsy. When they come to speak of a rigid athetosis, they are suddenly changing the meaning of athetosis, and for this fifth variety only they are using it to mean, not a type of uncontrolled movement, but the type of cerebral palsy. This is evident in the next sentence when they say that "extra-pyramidal rigidity is an athetosis". I think the authors should have decided on one meaning for "athetosis", or at least explained the several meanings they give to the word.

To say (p. 38) that "the role of the pædiatrician is more general than any of the other specialised fields" is not English and I doubt if it is good American. And the same goes for "the inability of response to questions by physical handicap. . . ." The meaning is usually clear but the construction makes some readers hesitate, feeling that something is wrong.

The book is brief and worth reading even though one's confidence in the neurological side is diminished by reading that "lesions of the cerebellum (are) characterised by the loss of postural sense". A "definite diagnosis" of cerebellum disorder is NOT "established by the presence of a positive Romberg sign". That is a sign of disorder of the posterior columns of the spinal cord. I like the authors' basic types of cerebral palsy given in Chapter III, and they might well have incorporated this into Chapter I as an improvement on the A.A.C.P. scheme. There is much wise advice on management, prognosis and relations, from which all of us could benefit.

R. C. MAC KEITH

ABSTRACTS

IN COLLABORATION WITH *"Abstracts of World Medicine,"* PUBLISHED BY THE BRITISH MEDICAL ASSOCIATION.

Ætiological Factors in Cerebral Palsy and Their Correlation with Various Clinical Entities.
S. BRANDT and V. WESTERGAARD-NIELSEN.

Danish Medical Bulletin Feb., 1958 **5**, 47-52, 10 figs., 6 refs.

An investigation of the cause of cerebral palsy among Danish children seen in clinics at orthopædic hospitals in Aarhus and Copenhagen is described. The disease was acquired in the prenatal or paranatal period in 87% of 628 cases and in the post-natal period in only 13%. Prenatal factors (31% of the total), including prematurity, accounted for 54% of cases of symmetrical diplegia and paraplegia and 41% of those of asymmetrical diplegia. Paranatal factors (31% of the total) were the most common cause of athetosis. Important single factors were prematurity (27%) and neonatal asphyxia (23%). Prematurity appeared to be 3 to 4 times more frequent as a cause of symmetrical spastic diplegia and paraplegia than of extrapyramidal hyperkinesia; in contrast, neonatal asphyxia was 3½ times more frequent in extrapyramidal hyperkinesia than in spastic diplegia. The risk of severe mental defect and motor dysfunction was greater in children with a history of neonatal asphyxia than in those with a history of prematurity only. Rh-incompatibility was observed in only two clinical sub-groups—spastic paraplegia (1 out of 81 cases) and extrapyramidal hyperkinesia (10 out of 84 cases). Multiple births were 4 times more frequent in the groups with spastic diplegia and tetraplegia than in normal subjects. None of the children in the series was delivered by cæsarean section. Genetic factors controlling the inheritance of neurological disease probably accounted for less than 4% of the 628 cases. The authors suggest that improved obstetrical technique, by lessening the incidence of prematurity, neonatal asphyxia, and Rh-incompatibility, might reduce the number of cases of cerebral palsy.

William Hughes

Orthopædic Surgery in Cerebral Palsy.
J. MORTENS and H. MOLLER. *Danish Medical Bulletin*, Feb., 1958. **5**, 52-58, 7 refs.

The role of orthopædic surgery in the treatment of cerebral palsy is discussed with reference to operations performed on 114 children, constituting 16% of the patients attending the clinic for cerebral palsy at the Orthopædic Hospital, Copenhagen, in 1950-56 inclusive. Only 6 patients underwent operations on the upper limb—arthrodesis of the wrist or tendon transfer or both—with functional improvement in 3 cases and cosmetic improvement in 2, one case being too recent for assessment. Altogether, 111 patients underwent operations on the lower limbs, as a result of which 7 patients were enabled to walk for the first time, 5 of them without support, and 74 others gained some improvement. The various individual procedures carried out totalled 325 in the whole series of 114 cases.

The authors favour early operation, to establish a better walking pattern, and particularly to control deformities of the knee and foot. In the earlier part of the period under review treatment was mostly by lengthening of the hamstring or gastrocnemius muscles or of the Achilles tendon, while Grice's method of foot stablisation was also used. In the later years the two operations described by Eggers —transection of the patellar retinacula with transplantation of the hamstring tendons to the femur, and patellar advancement by transfer to the tibial tuberosity—have been found of value. In the correction of deformities of the hip, although tenotomy of the adductor muscles with partial neurestomy has been performed with benefit in a number of cases, osteotomy in older children has given more satisfactory results. Neurectomy, apart from the obturator nerve, is considered to be rarely indicated.

The short period of observation in many of the cases is emphasised, and it is conceded that the favourable results may be only temporary. The improvement after surgery may be only slight, but in children with severe motor handicap even a slight improvement is to be welcomed.

Peter Ring

Sensory Disturbances in the Hands of Children with Cerebral Palsy.
M. O. TACHDJIAN and W. L. MINEAR, *Journal of Bone and Joint Surgery*, Jan., 1958, **40A**, 85-90, 3 refs.

The results of sensory examination of the hand in 96 children of average intelligence with cerebral palsy are reported from the Carrie Tingley Hospital for Crippled Children, Truth or Consequences, New Mexico. In each case 13 sensory tests were employed, including those for stereognosis, position sense, two-point discrimination, vibration sense, and temperature sense. Sensory impairment was found in 40 children (41.7%), the most common defects being those of stereognosis, two-point discrimination, and position sense, in that order. There was a high incidence of sensory defects in functionally disabled hands. The modalities chiefly affected are those which depend on the integrity of the sensory cortex; but inexperience in using the hand also plays a part and in some cases may be the major factor.

R. G. Rushworth

Ætiology and Pathogenesis of Laminar Cortical Necrosis. Its Significance in Evaluation of Uniform Cortical Atrophies of Early Life.
C. B. COURVILLE. *A.M.A. Archives of Neurology and Psychiatry*, Jan., 1958. **79**, 7-30, 11 figs, bibliography.

In this communication from the Cajal Laboratory of Neuropathology, Los Angeles, the author examines the problems posed by the condition known in the older literature as "status spongiosus". He first briefly reviews the historical aspects and the several concepts advanced regarding its pathology and pathogenesis, noting the early emphasis on anoxia and vascular insufficiency. He then draws on his own experience of a great variety of cerebral anoxic conditions to emphasise the wide variation in the degree of loss of the laminar nerve cells, which may range from that of scattered cells, mainly from Brodmann's lamina III, with or without status spongiosus, to subtotal cortical necrosis. He argues that the fact that lamina III has the densest capillary bed implies that its demand for oxygen is the heaviest. To account for some of the focal features in the distribution of the lesions—for example, in the depths of sulci—he invokes the occurrence of minor arterial occlusion and venous stasis. [The important possibility of the effects of œdema, stressed by Lindenberg, appears to have been overlooked.]

On the basis of these preliminary arguments he then analyses 7 groups of cases representing the various gradations of cortical atrophy of early life, which he regards as "a genuine hierarchy" of laminar cortical lesions, ranging from a selective laminar loss of nerve cells to almost total destruction of the brain mass. He shows that in all these cases the mechanism of anoxia was at work, regardless of the original cause. Finally, in an attempt to explain the diffuse cortical changes in early life he stresses the importance of paranatal asphyxia which, whether it be the result of birth injury or of some other cause, is the main pathogenic agent, acting either directly or setting in train secondary circulatory disturbances.

J. B. Cavanagh

A Cerebral Palsy Service for Children.
D. LAWSON, *Lancet*, April 19, 1958, **1**, 840-842.

An advice clinic for parents has been part of the cerebral palsy unit at Queen Mary's Hospital for Children, Carshalton, since 1945. This is largely an out-patient service but there is a small residential unit of 20 beds. Over the period 1954-6, 206 patients were referred to the clinic, 127 of whom had cerebral palsy in one of its forms, 68 were suffering from mental deficiency only and were referred to the appropriate authority, and 11 were not suffering from either cerebral palsy or mental deficiency. The type of cerebral palsy present, the degree of complicating mental defect, and the extent of incipient or established deformity were assessed, and the prognosis, both physical and mental, was explained to and discussed with the parents, the need for parental guidance of the child being stressed. The 127 cases were classified as follows: generalised spasticity, 76; variable rigidity, 19; athetoid cerebral palsy, 3; ataxia, 3; congenital hemiplegia, 21; and acquired hemiplegia, 5. After clinical assessment the patients were grouped according to the probable appropriate form of education of training as follows: (1) capable of receiving education at an ordinary school, 31; requiring education at a school for subnormal children, 30; "borderline of educability", 18; and ineducable, 48. The probable "social prognosis", having regard to mental and physical disability, was assessed as follows: ultimately independent, 65; partially dependent, 26; and dependent, 65. Of the 121 patients with congental cerebral palsy 43 had no history of complications during birth. The incidence of prematurity in the series was 45% (50 out of 109 infants).

The value of early diagnosis and appropriate guidance of the child's developing physical activity is emphasised. It is pointed out that only 13 of the children were referred in the first 18 months of life and 44 were over 5 years of age before they were seen. For a number of reasons, especially distance from the clinic and the presence of severe mental deficiency for which institutional management elsewhere was arranged, the advice clinic service was effectively used in only 61 of the 127 cases. The author emphasises that the residential unit is not used as a substitute for parental guidance, but rather for the purpose of instituting such guidance and overcoming early difficulties.

E. H. Johnson

The Prognosis in Cerebral Palsy.
P. PLUM, *Danish Medical Bulletin*, Feb., 1958, **5**, 58-65, 8 figs.

The prognosis in cerbral palsy is discussed with reference to the findings in 203 patients

observed at Rigs hospital, Copenhagen, for periods of 3 to 14 years. All the children were examined two or three times a year by the same physician and in many instances radiographs were taken. The author defines carefully the terms used in classifying the patients into 5 diagnotic groups—hemiplegia, paraplegia, tetraplegia, athetosis, and ataxia. The degree of motor handicap, speech defect, and intelligence defect were assessed on a three-point scale. Of the 124 children of school age, 76 had normal intelligence, and 53 of these attended the ordinary schools. Treatment included physiotherapy and exercises supervised by the parents in the home, speech therapy (in 62 cases), and orthopædic operations (25 cases). In the series as a whole there was satisfactory improvement in motor function in 39% of the cases, in intellectual development in 64%, and in speech development in 63%. The greatest improvement in motor function was observed in the group with hemiplegia, while speech development was best in the patients with tetraplegia.

The severity of a single handicap and the degree of mental defect were the most important factors influencing prognosis; when these were marked the prognosis was poor. Of 16 pateints with epilepsy and tetraplegia none showed normal intelligence, whereas of 56 without epilepsy 25 were of normal intelligence. The unfavourable prognostic effect of epilepsy was most marked in the patients with tetraplegia. A diminution in the circumference of the skull indicated a poor prognosis. The presumed cause of the cerebral palsy did not appear to influence prognosis.

William Hughes

Prognosis in Infantile Spasms.

L. L. BURNETT, E. L. GIBBS and F. A. GIBBS, *Pediatrics*, May, 1958, **21**, 719-721, 1 fig., 3 refs.

Spasms occurring in children under one year of age are usually characterised by one of the following: sudden jerking of the head, rolling of the eyes, a flinging upward of the arms, or quivering of the entire body. These movements are not rhythmical, and the attacks, although abrupt and of short duration, last longer than attacks of myoclonic epilepsy. Infantile spasms are usually associated with electroencephalographic (EEG) appearances of hypsarrhythmia, which consist in very high-voltage slow waves and random spikes of chaotic appearance. All epileptic manifestations in these children tend to decrease with increasing age, but the prognosis is very poor, since 11% die before the age of 3 years and 87% become mentally deficient.

In this paper from Logansport State Hospital, Indiana, the authors report a follow-up study of 34 children with infantile spasms (out of a total of 450) in whom the EEG was normal before the age of one year. Of these 34, 27 were followed up to a mean age of 4.8 years, mostly by correspondence with the patient's physician. It was found that 12 had some degree of physical retardation, a similar number was mentally retarded, and 7 had epileptic seizures during the follow-up period. In all these aspects the prognosis was more favourable than in those who had infantile spasms associated with an EEG picture of hypsarrhythmia. Of 8 patients who returned for a follow-up examination 4 showed a variety of abnormal EEG patterns; all 4 had physical or mental defects.

[This valuable study is somewhat marred by the method of follow-up and the lack of uniform assessment of the group.]

J. Lorber

Neurological Complications of Rubeola (Measles)

H. R. TYLER. *Medicine, Baltimore*, May, 1957, **36**, 147-167. Bibliography.

From 1919 to 1956 85 cases of measles with neurological complications were recorded at the John S. Hopkins and Baltimore City Hospitals. Of these patients, 10 died and 20 could not be traced, while 47 were personally followed up by the author, the average period of observation being 7·2 years.

Of the 85 patients, 67 (35 male and 32 female), of a mean age of 6 years, had encephalomyelitis. The clinical picture was variable, but the onset was usually characterized by an abrupt rise in temperature after it had returned to normal and the rash was fading, drowsiness, irritability, and headache. Physical examination was often negative and the whole illness commonly lasted only a short time. In 38 cases there were convulsions, which usually occurred as the temperature rose and were solitary; in a few cases, however, they were repetitive, and 4 patients died in status epilepticus. Cerebellar ataxia occurred as the only sign of nervous involvement in 3 cases, but was present together with other signs in 22 of the 67. Some of the patients [number not stated] became comatose; involvement of the cranial nerves in such cases was rare, though sixth-nerve palsy and nystagmus occurred, and frank decerebrate rigidity was also seen. The period of unconsciousness lasted from one to 40 days. Once recovery set in, it was progressive, if often slow; rapid recovery, even after prolonged stupor, was of excellent prognosis. Lumbar puncture was performed in 33 cases, in 29 of which the cerebrospinal fluid (C.S.F.) showed an increase in cells (lymphocytes) and protein; the colloidal gold curve and the pressure were normal in all cases. An electro-encephalogram (EEG) was recorded in 18 cases and was abnormal in all, the commonest abnormality being slow waves at 4 to 6 c.p.s. In most cases the record became normal after 3 to 8 weeks. Additional spinal involvement (myelitis), with absent reflexes, abnormal bladder control, or paraplegia, was present in 10 cases, but only one patient had isolated spinal signs. Five patients had visual difficulties on recovery from the acute stage, one being totally blind, but vision returned to all within 3 months. Three patients had transient mental disturbances (hallucinations), and many [number not specified] showed disordered personality traits and emotional instability in the post-

encephalitic period. In the blood a leucocytosis (up to 20,000 cells per c.mm.), with a shift to the left, was usual. The urine was normal in all cases. Of these 67 patients, 42 recovered completely, 7 developed subsequent convulsive disorders, 15 were mentally retarded, and 4 died.

Of the remaining 18 patients, 10 developed sudden hemiplegia. Unlike encephalomyelitis, there was no relationship between its onset and the fading of the rash, and in 5 cases the hemiplegia preceded the rash. C.S.F. studies were normal, but EEG tracings showed focal accentuation in the contralateral hemisphere. The paralysis persisted in all cases. Three patients developed acute cerebral oedema (toxic encephalopathy) on the 3rd to 7th day of illness, and all died. Bilateral retrobulbar neuritis occurred alone in 2 cases, with complete recovery, and choreoretinitis in one, with almost complete residual blindness. Two patients developed a toxic psychosis. There were no cases of cerebral thrombophlebitis or peripheral neuropathy.

Prognoisis for full recovery was worst in the hemiplegic group, in cases with a persistently low I.Q., and in infants. Prognosis for survival was worst in those with convulsions and toxic encephalopathy. It is recommended that the treatment should be conservative, lumbar puncture being contraindicated in cases with cerebral oedema.

[An excellent paper, which should be read in full.]

I. M. Librach

Infantile Cerebral Gliosis with Giant Nerve Cells

L. CROME. *Journal of Neurology Neurosurgery and Psychiatry*, May, 1957 **20**, 117-124. 12 figs., 7 refs.

Giant nerve cells are a familiar feature of tuberous sclerosis, but are non-specific as they are also found in other sclerotic conditions of the brain. In this paper from the Fountain Hospital, Tooting, London, the author describes 3 cases in children with intractable epilepsy, paralysis, and idiocy as the chief clinical features. Two of them came to necropsy and were found to have diffuse atrophy and gliosis affecting large but restricted areas of the cerebral cortex and the subjacent white matter. The histological picture resembled that of tuberous sclerosis, giant nerve cells being a prominent feature. The origin and significance of these cells seems to be obscure. It is considered that the condition in all 3 cases was probably congenital, but there was no evidence that they were due to the same cause.

R. G. Rushworth

Familial Spastic Paraplegia. Its Relation to Mental and Cardiac Abnormalities

J. M. SUTHERLAND. *Lancet*, July 27, 1957, **ii**, 169-170. 1 fig. 19 refs.

In this paper from Brisbane Hospital, Queensland, Australia, the author describes a family of 10 siblings, 3 of whom, males aged 32, 37, and 38 years, had spastic paraplegia. Signs and symptoms were first apparent at the age of 24, 26, and 21 years respectively, and were slowly progressive. Two patients showed slight cerebellar dysfunction and the third had some loss of vibration sense. No other member of the family was affected. In all 3 patients there was "slight but definite impairment of mental function". Two maternal aunts suffered from presenile dementia and among the offspring of the siblings were a mongol and an idiot. Although the electrocardiogram (ECG) in these 3 patients was abnormal the cardiac outline on fluoroscopy was normal. There was a history in the previous two generations of heart disease associated with sudden death—4 cases in all—and in one sibling the ECG was abnormal.

L. G. Kiloh

Key Stimulation for Spatial Turning Movements

(Schlüsselreize ramorientiereeder Zuwendereaktionen) S. WIESER. *Archiv für Psychiatrie und Nervenkrankheiten*, 1957, **195**, 373-382. 9 refs.

Behaviour experiments were carried out at the University Neurological Clinic, Hamburg, on severely demented patients with cerebral tumour, arteriosclerosis of the brain, general paralysis, and traumatic lesions, and on low-grade idiots and others. Their limited reactions, such as visual fixation, grasping, pouting, sucking, and snapping, to various stimuli were tested in an attempt to obtain a picture of their orientation in space (the propected orientation into the environment of Denny-Brown). The relation of these reactions to reflex and to higher integrated movements is discussed, as also is the explanation of the dissolution in terms of the concepts of Hughlings Jackson.

[An interesting and careful contribution to the psychobiological analysis of dementia.]

W. Mayer-Gross

Serial Oxygen Saturation Studies of Newborn Infants following Obstetrical Complications, Difficult Deliveries, and Cesarean Section

L. V. SHIELDS and E. S. TAYLOR. *American Journal of Obstetrics and Gynecology*, May 1957, **73**, 1011-1021. 6 figs., 10 refs.

The authors report serial measurements of the oxygen saturation of capillary blood in 66 full-term newborn infants delivered at the University of Colorado Medical Centre and St. Joseph's Hospital Denver, mostly after obstetrical complications, difficult delivery, or caesarean section. Readings were made photoelectrically with a double-scale, absolute reading oximeter every 2 minutes for 30 minutes after birth.

The babies were divided into six groups: (A) 13 control subjects—infants born by normal delivery under pudendal block without administration of analgesics to the mother; (B) 9 cases in which analgesics, including pethidine and morphine, were given to the mother within 90

minutes of delivery in addition to local analgesia, one being a breech delivery and 3 by forceps; (C) 10 babies born under intrathecal analgesia with cinchocaine (6 by forceps delivery); (D) 14 babies born under spinal analgesia (8 by forceps delivery) in the presence of obstetrical complications (including pre-eclampsia in 3 cases and abnormal presentations in 4), 2 of the mothers receiving analgesics within one hour of delivery; (E) 5 born under cyclopropane anaesthesia of up to 10 minutes' duration in the presence of severe obstetric complications, including abruptio placentae, prolapsed cord, and difficult breech delivery; (F) 15 delivered by caesarean section under spinal analgesia, including 2 for placenta praevia and one for maternal diabetes. The average blood oxygen saturation (%) at different intervals after birth in these groups were as follows:

Group	Minutes after Birth				
	2	6	16	18	30
A	75	90	—	—	95
B	49	72	—	—	86
C	65	85	—	—	93
D	38	64	80	—	91
E	46	49	—	80	93
F	65	74	—	—	94

The differences in the earlier values between groups A and B, C and D, A and E, and A and F were statistically significant. The authors also found that clamping the umbilical cord before pulsations ceased or the use of nasopharyngeal suction would reduce the blood oxygen saturation.

[These observations show that spinal analgesia, analgesic drugs, or caesarean section may result in an appreciable reduction of oxygen saturation in the baby's blood in the first minutes of life. Since the normal blood oxygen saturation of the foetus *in utero* is about 50 to 60%, this reduction may not be important clinically except when added to anoxia due to obstetric complications, when it might handicap the infant's chances of healthy survival.]

Pamela Aylett

Haemolytic Disease of the Newborn. Deaths in England and Wales during 1953 and 1955.
W. WALKER and P. L. MOLLISON. *Lancet*, June 29, 1957, **ii**, 1309-1314. 2 figs., 11 refs.

[Much of the value of this fully documented paper would be lost in an abstract, and those interested in the subject are referred to the original. The authors summarize their findings as follows:]

The clinical records of all infants certified as dying from haemolytic disease of the newborn in England and Wales during 1953 and 1955 have been examined. In each of the two years about 400 infants were certified as dying from haemolytic disease of the newborn. However, owing to the definition of haemolytic disease of the newborn for the purpose of certification, the label was often attached to infants dying from other conditions such as "kernicterus of prematurity", and the true number of deaths from haemolytic disease of the newborn was about 310 in each of the two years. Factors contributing to the deaths from haemolytic disease were failure to predict the disease antenatally, failure to recognize early clinical evidence of the disease, and failure to give adequate exchange transfusion.

Attention is called to the fact that the treatment of hæmolyic disease of the newborn is underaken at a very large number of hospitals. In many of these the number of cases seen is very small, and it is therefore impossible for the staff to gain the necessary experience and familiarity with this condition. It is suggested that, if all cases of haemolytic disease of the newborn (due to anti-Rh(D)) were predicted antenatally and were treated when necessary by early adequate exchange transfusion, the present death-rate could be greatly reduced. Each year, in England and Wales, more than 150 infants would be saved.—[Authors' summary.]

Infantile Subacute Necrotizing Encephalopathy with Predilection for the Brain Stem
R. B. RICHER. *Journal of Neuropathology and Experimental Neurology*, July, 1957, **16**, 281-307. 10 figs., 22 refs.

The clinical and pathological findings in 3 infants suffering from a condition which is considered to be a nosological entity are described. The infants, who were seen at the University of Chicago Clinics, presented a similar clinical picture of early feeding difficultes, slowness or lack of development with, eventually, motor and sensory deterioration, impaired pupillary reactions, apparent blindness and deafness, evidence of pyramidal-tract involvement, and convulsions late in the disease. Symptoms were usually seen during the first year of life, and death occurred before the age of 4 years. The author states that the clinical picture cannot be distinguished from that in other infantile diffuse cerebral affections.

The pathological changes were centred in the brainstem and the basal ganglia, although the cortex and white matter might also be involved. The lesions were essentially multiple focal necroses or partial necroses, often extensive and sometimes with a tendency to bilateral symmetry. Cytologically, all components were damaged in the complete lesion, while neurones and axons might survive where the damage was partial. Capillary proliferation was conspicuous, and reactive glial changes were pronounced.

No casual agency was found. Vascular and inflammatory processes were excluded as pathogenic factors, the similarity with Wernicke's syndrome was not complete, and exogenous thiamine deficiency was not considered to be a casual agent. Anoxia at birth was also excluded, although in one case there were sym-

toms soon after birth. The author points out that he has produced similar brain damage in animals by intoxication with quinoline compounds, carbon disulphide, and carbon monoxide, and suggests that the disorder is due to a mechanism involving the failure of an enzymatic pathway, either induced by a toxin or through endogenous deficiency. A slight tendency for the involvement of siblings is cited in support of this view. Attention is drawn to 4 similar cases recently reported—3 in the U.S.A. and one in Britain.

J. B. Cavanagh

Change of Acoustic Function in Word Deafness
(Akustischer Funktionswandel bei Sprachtaubheit)
H. E. RICHTER. *Archiv für Psychiatrie und Nervenkrankheiten*, 1957, **196**, 99-113. Bibliography.

From the Neuropsychiatric Clinic of the Free University of Berlin the author reports the case of a 43-year-old woman with cerebral vascular disease who had suffered an attack of temporary aphasia 13 years previously. A second episode of sensory aphasia was not followed by restitution of function, and a new cerebral vascular insult about a year later further worsened the aphasia. Cerebral angiography aroused suspicion of an obliterating thromboangiitis. The case history indicated that the patient, who was right-handed, had a left-sided lesion initially, which was compensated for by the right hemisphere. The second lesion was on the right side. A connexion between left-sided anomalies in the audiogram and word deafness was excluded. There were, however, psychological symptoms—for example, slowness and perseveration as well as emotional blunting and apathy.

Detailed examination showed that while there was only a slight reduction in spontaneous speech, understanding was seriously impaired, as also was the repeating of spoken words. Sense of rhythm and the perception of melodies were seriously disturbed. In order to differentiate between acoustic factors and factors of higher perceptive function a special test-situation was designed which allowed almost isolated observation of the acoustic function. In this situation there was a significant difference between the patient's recognition of tactile and visual stimuli on the one hand and of acoustic stimuli on the other, proving the presence of an elementary acoustic disturbance at a frequency of stimulus of 80 per minute. The author found a remarkable correspondence between the defect of language perception and the inability to reproduce acoustic stimuli. He concludes that the acoustic perceptive deficiency might explain the disturbance of language perception, that is, the word deafness.

[If similar auditory disturbances could be found in other cases of sensory aphasia, this would be an important contribution to the understanding of higher speech anomalies.]

K. Schmalbach

A Further Study of Visual-spatial Agnosia
G. ETTLINGER, E. WARRINGTON, and O. L. ZANGWELL. *Brain*, Sept., 1957, **80**, 335-361. 6 figs., 45 refs.

Recent studies of visual-spatial disorder associated with unilateral cerebral lesions are reviewed. Ten cases are reported in which right-sided posterior cerebral lesions in right-handed patients gave rise to characteristic disturbances in spatial perception and manipulative skill. The findings are evaluated with special reference to recent theories of visual agnosia. It is concluded that disorders of visual space perception are not wholly referable to impairment of differential visual sensitivity, unilateral visual extinction, central vestibular derangement, or to a combination of these factors. Nor are they to be viewed as secondary to general intellectual impairment, which was appreciable in only one case. A tentative explanation in terms of restriction of the field of visual attention associated with some degree of conceptual spatial loss is put forward. The relation of visual-spatial agnosia to constructional apraxia and kindred high-grade disorders of manipulative skill is briefly considered.—[Authors' summary.]

Children with Cerebral Palsy. Cost of Care and Results in 770 Children
H. M. WALLACE, M. A. LOSTY, D. SANDERS, R. S. SIFFERT, J. S. TOBIS, and H. RICH. *Pediatrics*, Oct., 1957, 20, 703-715. 2 figs.

The cost of the treatment and management of children with cerebral palsy was assessed from the records of all children suffering from this disease who received care under the New York Financial Aid Program from 1945 to July, 1954. A total of 799,860 dollars was spent on 770 children, an average of 1,039 dollars on each child. Over half of this sum went on convalescent care, one-third on hospital care, and one-seventh on appliances. This expenditure did not represent the total cost, because the in-patient care of the children cost more than the amount contributed under the scheme. On 440 of the children the average expenditure per child was 139 dollars; this was for appliances only. On the remaining 330 the average expenditure was 2,239 dollars, which included the cost of in-patient care and convalescence as well as appliances. About one-fifth of all children showed improvement in a wide field of activities, the greatest improvement being recorded in those who were only moderately handicapped. Discussing the considerable sum spent on convalescence, the authors suggest that the money might have been better spent on care in a fully-staffed hospital where better and quicker results would be obtained in the severely handicapped. Further, some of the money allocated to in-patient care might be used for developing other services, such as special classes in schools, "foster home placement", and better out-patient service. The outcome of treatment and rehabilitation was more favourable in children with athetosis and paraplegia or hemiplegia than in those with quadriplegia or generalized involvement. It was estimated that at least 243

of the children would need residential care.

[This is an interesting investigation, and the general conclusions seem to be in accord with views widely held in Britain. A similar inquiry in Britain might be difficult because of the differing arrangements, but it would be of great value in determining exactly how funds could best be allocated and in avoiding any tendency to piecemeal spending.]

J. G. Jamieson

Control of Motor Function in the Treatment of Cerebral Palsy

K. BOBATH and B. BOBATH. *Physiotherapy*, Oct., 1957, **43**, 295-203. 7 figs., 9 refs.

The patient with cerebral palsy cannot normally direct the nervous impulses for the contraction or relaxation of specific muscle groups in voluntary movement; the muscles are there, but control is lacking and coordination is abnormal. The normal person has many patterns of muscular activity at his service which are coordinated in detail by the subcortical centres. But in cerebral palsy only a few such patterns are available and these are abnormally coordinated. Moreover, lower reflex activities are released from higher control and large masses of muscle are activated even for finer movements, so that the patient suffers both from loss of function due to destruction of brain cells and also from "release symptoms" due to the overactivity of uninhibited lower centres. Thus released spinal reflexes result in motor patterns of total flexion or extension, and released tonic reflexes, activated by the labyrinth or the proprioceptors of the neck, produce maximal extensor tone in the supine position and maximal flexor tone in the prone position. Various combinations of reflex preponderance are found according to the severity of the cerebral damage, abnormalities of both voluntary and reflex movement being present.

The normal child learns to modify his reflex patterns as he grows up, and the righting reflex is gradually inhibited as he develops. But both the righting reflexes and the maintenance of equilibrium require normal muscle tone, which is lacking in the spastic child. In teaching skilled movements, therefore, released tonic reflexes must first be suppressed in order to reduce spasticity and produce a more normal muscle tone. But while abnormal reflex activity must be suppressed, at the same time normal automatic activity must be encouraged. The child must be taught "reflex-inhibiting postures" to break up his abnormal postural patterns, the head, spine, and shoulder-girdle being first positioned so as to reduce spasticity and allow of correct activity of the limbs. While basic postural patterns are similar for all children, each is an individual and his own particular patterns must be analysed. Resistance to the adoption of reflex-inhibiting postures indicates a profound inability to perform essential movements, whereas if it can be overcome widespread improvement in movement will be obtained. But the correct acquisition of these reflex-inhibiting postures can be very difficult for the child, and much depends on the skilled assistance of the physiotherapist which must, however, be gradually withdrawn if the child is to acquire the ability to adopt the correct posture by himself. As inhibiting postures are learnt, normal movement patterns can be taught. Sometimes in older children it is necessary to go back to the fundamentals, for wrong patterns may have been acquired The acquisition of correct automatic motor activity should precede that of willed movements, and to facilitate this the correct reflexes must be stimulated, for automatic movements cannot be taught as exercises. The authors give examples of the practical application of these methods, and illustrate them with photographs.

[This is a long and involved paper; not everyone would accept the tenets on which the authors' conclusions are based.]

W. Tegner

Blood Oxygen Studies in Premature Infants

P. M. RUSSELL and F. P. HUDSON. *Archives of Disease in Childhood*, Oct., 1957, **32**, 392-396. 4 figs., 13 refs.

In the blood oxygen studies here reported from the University of Liverpool the haemoglobin value was determined and the oxygen saturation estimated micro-gastrometrically in the blood collected by heel prick in 40 premature infants, in some of whom the effect of the administration of oxygen was also studied. The mean value for blood oxygen saturation in these subjects was 88%, compared with 93% in full-term infants. Increasing the blood oxygen tension by administering oxygen for short periods caused a rise in the oxygen content and saturation of the blood on 21 of the 23 occasions on which it was tried. The authors stress that there was no indication that increasing the oxygen tension was of any benefit to these infants nor that such treatment was required, and conclude that the routine estimation of blood oxygen values is not likely to assist in the management of healthy premature babies.

Wilfrid Gaisford

Late Cerebral Sequelae of Icterus Gravis Neonatorum. (Cerebrale Spätschäden nach Icterus gravis)

L. BALLOWITZ and G. FLEISCHHAUER. *Monatsschrift für Kinderheilkunde*, Sept., 1957, **105**, 328-333. 27 refs.

The signs of early cerebral damage in infants may soon disappear, so that the long-term sequelae may, after a variable latent period, appear in apparently undamaged patients. The symptomatology and nosology of the late sequelae are discussed with reference to the literature and to 135 cases of erythroblastosis foetalis seen at the Paediatric Clinic of the Free University of Berlin since 1947. Exchange transfusion was performed in 125 cases for Rh sensitization and in 10 for blood group A or B incompatibility; 19 of the infants died in the neonatal period or soon after. In the early part of the study Rh blood was scanty and therefore after the first 400 ml. of each trans-

fusion Rh blood was given. The results, however, were not good and after 1950 only Rh blood was used, since when the results have improved dramatically, the mortality among 111 infants receiving exchange transfusions in this period being 6·3%.

Follow-up examination, including passive and muscular function tests and intelligence tests, was carried out every 3 to 6 months and details for 86 of the children are presented. Of 40 children now over 3 years of age, 36 are well and healthy. Of the remaining 4, whose history and findings are briefly outlined, one suffers from athetosis, torsion spasm, and mental defect, a second has spastic hemiparesis and mild muscular atrophy, the third shows convergent squint and mild mental defect, while in the fourth behaviour disorders are reported. Another 36 children are now aged between 1 and 3 years and these are all well, as are the remaining 10 infants now aged 6 months to one year. This last age group is that in which cerebral damage as a late sequela usually first becomes apparent.

Another 32 infants with icterus gravis were seen but not given exchange transfusion either because they were admitted *in extremis* or too long a period had elapsed after birth; of these, 11 died within a few hours of admission. A further 8 who were admitted after the fourth day of life with severe haematological symptoms were given small blood transfusions or cortisone, but only one of the 4 survivors of this group is quite normal. Lastly, of 12 children admitted late but with only slight haematological symptoms, 9 are alive; 3 of these are known to be normal and one to have athetosis and opisthotonos.

The authors conclude from these results that exchange transfusion not only lowers the immediate mortality in icterus gravis but also largely prevents late cerebral damage. From a study of the development of such cerebral damage, however, no regular pattern of symptoms could be recognized. The authors recommend that exchange transfusion should be given even if the haematological symptoms are only mild, provided the direct Coombs test is positive and the child is seen soon after birth, but is not justifiable after the third day without icterus even although the Coombs reaction is positive. Patients admitted late with severe icterus present a special problem, because cerebral damage may already be present and indeed was present in 2 such cases, although 5 other similar infants appeared to have escaped this complication.

F. Hillman

Clinical Evaluation of Zoxazolamine (Flexin) in Children with Cerebral Palsy

M. WATKINS and M. H. HALE. *Journal of the American Medical Association*, Oct. 19, 1957, **165**, 830-833.

An assessment, as far as possible objective, of the value of zoxazolamine in the treatment of children with cerebral palsy was made at the Cerebral Palsy Treatment Centre, Dallas, Texas on 68 spastic and 27 athetoid patients aged 2 to 17 years, with a random distribution of intelligence levels. The drug was tested for its effect on the stretch reflexes, on the ability to perform a previously learned task and to climb stairs, and on the control of the muscles of speech articulation. Of the 95 children, 68 were given zoxazolamine in a dosage of 250 mg. three times a day and 27 a placebo. However, because of the development of dizziness, hypotonia, and a rash among the younger children this dosage was later reduced to 125 mg. three times a day in all patients under the age of 5. No appreciable benefit was demonstrated in the treated patients as compared with the control group. While hesitating to affirm that zoxazolamine (like many other drugs) is of no value in cerebral palsy, the authors conclude that, in the dosage here employed, its effect was mainly psychological.

N. S. Alcock

Quantitative Assessment of Motor Function in Cerebral Palsy. Evaluation of Zoxazolamine (Flexin), a New Muscular Relaxant Drug.

J. G. MILLICHAP and R. HADRA. *Neurology* Dec., 1956, **6**, 843-852. 4 figs., 11 refs.

Simple quantitative tests devised by the authors at the National Institute of Neurological Diseases and Blindness, Bethesda, Maryland, for the assessment of motor function in children with cerebral palsy are described. They included estimation of the range, speed, power, and coordination of voluntary movements, and kymographic and other balance. A technique is also described which makes it possible to assess the extent to which improvement in performance is due to practice.

These tests were used to evaluate the treatment of 10 children with cerebral palsy with zoaxazolamine ("flexin", 2-amino-5-chlorobenzoxazole). Four of the children had spastic quadriplegia, 2 spastic hemiplegia, and 4 athetosis. The drug was given in doses of 0·75 to 1·5 g. daily for periods of a month, alternating with placebo tablets for similar control periods. The drug depresses polysynaptic pathways in the spinal cord, having a more prolonged action than mephenesin and only a weak neuromuscuiar blocking action. Significant improvement occurred in 6 cases, being most evident in cases of athetosis without weakness. Side-effects such as nausea, vomiting, urticaria, and an increase in the frequency of fits occurred in 4 cases. In a limited comparative trial chlorpromazine (one case) and reserpine (4 cases) tended to impair functional ability, although the former has been shown to diminish spasticity.

J. Foley

Low Oxygen Tension in the Management of Newborn Infants

S. SJÖSTEDT and G. ROOTH. *Archives of Disease in Childhood*, Oct., 1957, **32**, 397-400. 3 figs., 30 refs.

Because of the immaturity of the enzyme system in premature infants and the increased

susceptibility of their blood vessels to the strain of a sudden increase in oxygen tension (as evidenced by the occurrence of retrolental fibroplasia and hyaline membrane) the authors have investigated the effects of nursing premature infants in atmospheres of reduced oxygen tension.

At the University Hospital, Lund, Sweden, 21 full-term and 12 premature infants were kept in incubators at 25°C. and in an atmosphere of 15% oxygen and 85% nitrogen. The premature infants were treated for periods up to 5 weeks

The results were encouraging in both groups. The premature group included two sets of twins and the smaller member of each pair was treated in the low oxygen tension incubator while the other was nursed in room air. The general condition was better in the treated infants in both cases. These results have encouraged the authors to recommend this regimen for anoxic and premature infants in the hope of achieving a higher survival rate and fewer cases of retrolental fibroplasia, hyaline membrane, and cerebral palsy. During the infants' stay in the incubators the heart and respiration rates were recorded and the retinal vessels inspected regularly, while an oxygen analyser was used frequently to check the oxygen tension inside the incubator. With continuous drip feeding via an indwelling nasogastric tube the infants could be nursed in the incubators for at least 23 hours a day.

Wilfrid Gaisford

Rubella during Pregnancy. A Patho-anatomical Study of Fœtuses. I. [In English].
R. LUNDSTRÖM. *Acta pathologica et microbiologica Scandinavica* 1957, **41**, 449-461.

During a widespread epidemic of rubella in Sweden in 1951 the opportunity arose for studying 205 fœtuses from women who had contracted the disease in the early stages of pregnancy (therapeutic abortion in 197 cases and spontaneous in 8). Fœtuses obtained in 15 cases at therapeutic abortion for reasons other than maternal rubella served as controls. Because of the volume of work involved in examining fully all these fœtuses the investigation was confined to 67 cases in which maternal rubella had been diagnosed by a physician. The present paper, a first report, is concerned only with the macroscopical findings. The smallest of the 67 fœtuses, after external examination, were embedded in paraffin for later microscopical study. Gross external malformations were observed in only 2 of the 67 fœtuses, while internal examination of the remainder revealed gross abnormalities in only 2. The author does not consider that the abnormalities in these 4 instances were attributable to maternal disease. In 10 fœtuses there was damage to the eyes, but this probably occurred during removal of the fœtus from the uterus.

The radiological and microscopical findings are to be the subject of a subsequent report.

J. B. Wilson

Hip Dislocation in Cerebral Palsy
M. O. TACHDJIAN and W. L. MINEAR. *Journal of Bone and Joint Surgery*. Dec., 1956, **38A**, 1358-1364, 17 refs.

Of 590 patients with cerebral palsy, seen at the Carrie Tingley Hospital for Crippled Children, Truth or Consequences, New Mexico, 25 (4·24%) showed evidence of dislocation or subluxation of the hip. Radiographs in 20 of the 25 patients disclosed an average coxa valga of 170 degrees, with a maximum of 178 and a minimum of 160 degrees. In 6 patients with 7 affected hips the acetabular index was over 25 degrees. The sex and age incidence, ability to bear weight, and the type of cerebral palsy are discussed; 23 of the 25 patients had spastic cerebral palsy. The dynamic imbalance of the muscles about the affected hip was studied in repeated composite muscle tests. The authors point out that in examining the muscles of a child with cerebral palsy, tension athetosis should be distinguished from spasticity. Tension athetosis is produced by the intentional effort of the athetoid patient to prevent any undesired movement of the limb. Voluntary tension can be recognised by shaking the limb, when the tension can be lessened. The spastic limb, however, resists shaking, the spastic position being maintained.

The treatment of these patients and the end-results are discussed, the importance of prophylactic tenotomy of the spastic hip adductors and of strengthening the motor power of the abductors being emphasized. The authors state in conclusion that dislocation of the hip in cerebral palsy is preventable. "If we are aware of the probabilities and understand the pathomechanics, every child with spastic lower limbs will be regarded as in danger of having either subluxation or dislocation of the hip."

Leon Gillis

The Diagnosis of Cerebral Phlebitis in Children. Value of Extracranial Venous Signs. (Le diagnostic des phlébites cérébrales chez l'enfant. Valeur des signes veineux extracraniens)
M. BERNHEIM and F. LARBRE. *Archives françaises de pédiatrie* 1956, **13**, 1021-1042, 5 figs., 6 refs.

From the Hôpital Edouard-Herriot, Lyons, the authors describe their experience in 15 cases of cerebral phlebitis in children, with special reference to diagnosis. Clinically the syndrome may present in three different forms. (1) Superacute cases, starting suddenly and progressing rapidly to death; of the 4 cases in this group 2 are described in detail, including the post-mortem findings. (2) Cases also characterized by sudden onset of fever, convulsions, and coma, but in this type the convulsions tend to be focal and recovery soon sets in, although there are usually permanent sequelae in the form of hemiplegia or mental deterioration; of the authors' 3 cases of this type the clincal details of one are presented. (3) In the third type (8 cases) the initial signs and symptoms are the same as in the other groups, but here the patients recovered completely and left the hospital without any signs of permanent

neurological damage. The aetiology of the cerebral phlebitis could not be established with certainty in every case. Aural or mastoid suppuration or cutaneous infection of the face or scalp seemed to be the most frequent causes.

The clinical diagnosis depends upon the recognition of the sudden onset of convulsions accompanied by high fever and localizing neurological signs, or (as occurred in 3 of the present cases) there may be signs of intracranial hypertension without evidence of neurological localization. The discovery of infection of the ears, upper respiratory passages, or the skin, the presence of prominent scalp veins and oedema of the tissues, together with leucocytosis and changes in the cerebrospinal fluid suggestive of meningeal reaction assist greatly in diagnosis. The particular superficial veins which are thrombosed are often a guide to which sinus is the site of the phlebitis. Changes in the electroencephalogram may also be of additional diagnosic value, and some characteristic records in the series are described in the text.

In discussing the treatment the authors lay particular stress on the early use of anticoagulants (particularly heparin) in addition to vigorous administration of antibiotics.

Marcel Malden

Clinical Features of Children Suffering from Neurological Sequelae of Rh Iso-Sensitization

C. BURTON-BRADLEY *Australian Annals of Medicine*, Aug., 1956, **5**, 203-213. 2 figs., 15 refs.

The author reports the results of a study, carried out at the Spastic Centre, Mosman, New South Wales, on a group of 18 children who suffered from neurological lesions after recovery from icterus gravis neonatorum. In most cases blood transfusions varying in number from one to five had been given. The ages of the patients at the time of examination ranged from 8 months to 8 years. In the early days of life some of the affected children in this series had shown varying degrees of opisthotonus, but later there was apparently complete recovery of function and feeding was usually established normally.

The first sign of a permanent neurological defect was a persisting delay in either walking or speaking. When the ability to walk was acquired it was accompanied by a disturbance of gait (the "toe-heel" gait), which the author regards as highly characteristic of these patients; it is similar to that seen in children with athetosis, which was present in 17 of the 18 children. Among other neurological abnormalities encountered was a defect of ocular movements most commonly affecting upward movement of the eyes. Also frequently noted was deafness to tones of high frequency, and the author stresses the importance of recognizing the handicap, which together with the dysarthria associated with the athetosis, is an additional difficulty in the education of these children. The author also notes the presence of hypoplasia of the enamel of the deciduous teeth, causing the characteristic "Rh hump" at the gum line in 17 of the patients. Two detailed case histories are presented.

Fergus R. Ferguson

Basic Teaching-Training Principles for the Patient with Cerebral Palsy

H. E. HIPPS. *British Journal of Physical Medicine*, Feb., 1957, **20**, 34-39. 4 refs.

At one time patients with cerebral palsy were treated by "physical therapists" who learnt their methods by trial and error, some methods being good and others useless. When, however, children with cerebral palsy in the United States were assigned to the care of school teachers excellent results were obtained, and this, the present author claims, was because the teachers had been trained to teach. He goes on to elaborate his theme, that the fundamental concepts of teaching and training are just as applicable to the teaching of spastics as to the teaching of normal children; the latter learn by imitation, trial and error, repetition of effort, and sometimes by reason or insight, and the child with cerebral palsy should do the same. Spastic children must learn by doing, and the tedious training in how to relax should be abandoned in favour of learning by imitation and trial and error. They should be taught either individually or in small groups of 3 or 4, larger groups being less satisfactory.

A normal child first learns to hold his head up, then to sit up, then to stand, and then to walk. These are the natural stages of maturation, and they should be the stages in the training of the spastic child. He should be taught only one activity at a time, and must not be confused by attempts to teach him several things rapidly. Constant and prolonged repetition is necessary, because the spastic child learns very slowly. Reward and praise should immediately follow successful achievement. A motive for learning must be introduced, so that the training will make sense to the child. Finally, it must not be forgotten that mental development must proceed at the same time and be equally encouraged.

W. Tegner